Quarterly Progress Report
(Field Office Project Template)

Project Title: Kentucky Rural Energy Supply Program
Award Number: [DE-FG36-05GO85013]

Recipient: University of Kentucky
Project Location: [Lexington, KY]

Reporting Period: [July 31, 2007 to October 31, 2007]
Date of Report: [October 23, 2007]
Written by: [Michael Montross]

> **IMPORTANT NOTE:** If any part of your quarterly report contains **proprietary/confidential information**, or details that should not be released to the general public, the specific sections of the report should be marked as such, by clearly marking the beginning and end of the confidential information. The marked sections will not be released to the general public or any unauthorized parties.

Status: [In this section each task, as defined by the Project Management Plan (PMP), should be discussed by following the outline given below. The discussion for each task should include subtasks. Milestones, deliverables, and go/no go decision points covered in Table C of the accompanying excel quarterly report and the PMP may be discussed in more detail in this section; however, please ensure Table C is completely and accurately filled in.]

April 1, 2006 – June 30, 2006
Initial experiments have been conducted to produce ethanol in the lab using ensiled and field dried corn stover samples. Initial results demonstrated that ensiled samples did not have major inhibitors. Assays and equipment to measure ethanol produced have been verified.

July 1, 2006 – September 30, 2006
Composition analysis of field dried samples has been performed and the samples pretreated. Protocols have been developed to ensure that energy and mass balances can be verified. Dried corn stover samples have been pretreated and simultaneous saccharification and fermentation performed in a 10L reactor. Initial results indicated that the fermentation went to completion and the experiments for the project can begin.

October 1, 2006 – December 31, 2006
Material was collected prior to corn harvest on September 27. It was dried in the laboratory and will provide a reference point for all of the material collected and stored in the field. There were two hybrids harvested (Pioneer 33R77 and 33M54). The combine chopper and chaff spreader were disengaged to allow for the biomass flowing through the combine to be dropped into a windrow to produce the high value corn stover. The windrow was baled using a round baler and the distance covered and time required to produce each bale recorded. The remaining material between the windrows was also baled and contained primarily stalks (low value). Bales were weighed, sampled, and a bale wrapper used to ensile each individual bale. Compositional analysis of the hand harvested samples and baled material are in progress. A silage pile was not used due to the high losses encountered with a silage pile made the previous year. Instead bales were produced that were wrapped in plastic, a practice common on farms that will result in

silage. This will allow other collaborators to have access to the material and will improve the statistical tests used in the analysis

January 1, 2007 – March 1, 2007
The bales were sampled and prepared for compositional analysis and organic acid profile. Initial compositional results have shown that there was a slight decrease in glucan content of the ensiled bales relative to the preharvest corn stover. However, this was probably due to the loss of soluble sugars during the ensiling process. There appears to be no difference in the composition of the two corn varieties tested or between the high and low value material. The corn stover collected during the second harvest has not been analyzed, although the soil contamination is so severe there may be no value to the material. Collecting dry corn stover was not very effective. Tests indicated that the soil contamination was greater than 15% which would not be practical from a biorefinery point of view.

April 1, 2007 – June 30, 2007
Compositional analyses of the bales were performed using NIR calibrations available from INL and wet chemistry techniques at UK. Procedures for measuring the organic acid profiles are being refined. There are numerous published procedures for measuring the organic acid profile and the advantages/disadvantages of each technique are still being evaluated. Pretreatment and SSF experiments have been unsuccessfully conducted on the samples collected. Although, previous experiments to verify the protocols worked earlier this year. It is believed that the enzymes or yeast have become contaminated or lost their activity. We are working with Alltech Inc. to achieve a more optimal blend of enzymes to perform the SSF. Collecting dry corn stover was not very effective. Tests indicated that the soil contamination was greater than 15% which would not be practical from a biorefinery point of view.

July 1, 2007 – September 30, 2007
Pretreatment and SSF experiments have been conducted on the samples collected. Two pretreatment levels were investigated for each collection strategy. Samples were pretreated with 0.2N and 0.4N NaOH at room temperature for 2 hours. The samples were repeatedly washed and enzymes and yeast were added. Samples collected prior to ensiling were not statistically different than samples after 6 months of ensiled storage. This indicates that the ensiling process should not cause problems with further downstream processing. Pretreatment with 0.2N NaOH allowed for 51 and 44% of the glucan to be converted to ethanol in the high value versus low value samples. Increasing the pretreatment level to 0.4N NaOH resulted in 58 and 44% of the glucan to be converted to ethanol in the high and low value samples. These conversion efficiencies are very low, but the objective of this research project was not to optimize the system, but to demonstrate the effect of collection strategy on ethanol production. The low ethanol conversions could be due to the different optimal temperatures for the yeast versus the enzyme. Tests are being completed to evaluate the yields from separate hydrolysis and fermentation.